STUDIES IN TETRAGONEURIA (ODONATA).

By Richard A. Muttkowski.

A revision of the genus *Tctragoneuria* presents a series of difficulties which fully equal those of other genera of *Odonata*, such as *Argia*, *Neurothemis*, *Erythrodiplax*, *Perithemis*, *etc.* The close resemblance of the species, the generalized genitals and but little specialized anal appendages, and the variability of wing markings and wing venation are factors which tend to make a mechanical separation of the species difficult, if not impossible cn occasion.

The genus *Tetragoneuria* has always, more or less, belonged to the category of "Splitters' and Lumpers' Paradise". The tendency to regard color extremes as indicating specific validity, as also the other extreme—to regard them as a series showing the gradual development of one species—is well marked in the writings on the subject. Either tendency seems to have been based on the amount of material available to the respective author.

The present study had its origin in 1909, when the Milwaukee Museum expedition to the St. Croix river furnished a series of about thirty specimens. Coincident with this material some specimens were received from Florida for determination, a fair share of which fell to the Museum. This together with material already on hand formed the nucleus of a brief study, in which the following conclusions were reached:

(a) The T-spot. as far as *cynosura* is concerned, is an unreliable character. For the material showed all gradations from a rudiment of the T-stem to the fullest development of the T-cross.

(b) The specimens from Florida are not identical with those from northern states.

(c) A query. What is the distinction between cynosura, basiguttata, semiaquea and indistincta (semiaquea as interpreted by recent authors)? Er. Martin's table (Cordulines, p. 45, 1908) offered no help in this matter. Strictly taken, over half of the specimens on hand would be referable to *indistincta* Morse; on the other hand, the identity of the specimens of the St. Croix series was unmistakable. This was as far as I went at the time. Later, in 1910, when rearranging the collections, a more careful examination of the material was made with a view toward the discovery of constant specific characters. One result was the discovery of T. morio n. sp., whose color resemblance to the other specimens had caused me to overlook it previously. Characters seemed plentiful and were fairly constant in most cases. Yet since the material was regional, it could be assumed that at least some of the characters were likewise regional. Eventually this proved to be the case.

Before attempting to describe T. morio I found it imperative to ascertain the exact values of existing species. The various descriptions seemed confusing, and in a number of cases did not agree at all with the original descriptions.

It was necessary to obtain additional material, especially from the Austral region. Such was kindly supplied by Dr. Philip P. Calvert of Philadelphia, Mr. E. B. Williamson of Bluffton, Ind., Dr. E. M. Walker of Toronto, Ont., Messrs. C. S. Brimley and F. Sherman, Raleigh, N C., and the U. S. National Museum.

Dr. Calvert's material showed a number of interesting forms from diverse and widely separate localities. Mr. Brimley's and Mr. Sherman's material was entirely from North Carolina and was for that reason especially welcome. As usual, Mr. Williamson furnished the richest material, rich in number, variety and localities. That of Dr. Walker was regional. The National Museum specimens covered several regions untouched by the remaining lots.

CHARACTERS.

The characters considered in this study may be conveniently classed into venational, structural and color characters.

Venation.—A comparison of the tables will show that there is a very gradual increase in the venation, with *cynosura* and *canis* as the two extremes. Yet this increase is so gradual and the amount of variability from the mean is so great that the venation cannot enter as a factor in the determination of the more nearly related species. The antenodals increase from six to ten in the fore wings and from four to six in the hind wings. The postnodals increase in a less striking manner. Co-ordinate with the increase of the latter we find the postnodal-radial space (Williamson) lenghtening and the substigmal series of two to four veins retreating from the third to the fifth postnodal.

The origin of the cubito-anal crossvein—coincident with A_4 or distal thereto—seemed a constant factor in Wisconsin material; the tables showed otherwise for other regions.

The crossing of the triangle of the forewings may be set down as a generic feature, for it is constant, with rare exceptions, in all specimens seen by me. Only in *spinigera* and *canis* are the triangles of the hind wings found crossed, but this is the case in only 50% of the specimens so that no specific value can be attached to this character.

Structure.—The form of the abdomen is an uncertain feature. Here also a progression from parallel to broadly spindle-shaped abdomens takes place, with *stella* and *spinigera* at the two extremes. As a rule, the constriction of segment three is fairly well pronounced and segments nine and ten are markedly narrower than the preceding ones, and the species so labeled (as spindle-shaped) are therefore easily recognizable.

The form of the male appendages is the chief character of distinction, though subject to some variation, at least in the *cynosura* series. The female appendages show little variation in a species and this character has formed the chief distinction between females of the various species. If taken in conjunction with other characters, I believe, a species cannot be easily mistaken.

Colors.—The general color is subject to little variation. All have practically only one type of color pattern, with slight individual variation. The chief feature is the T-spot, which apparently is constant in most species by its presence or absence, though extremely variable in *cynosura*.

The question of wing coloration is taken up more fully under *cynosura* and *semiaquea*.

Distribution.—The genus *Tetragoneuria* covers a greater portion of North America. Few specimens have been collected in the west, though the species undoubtedly occurs in the western states, as proven by material obtained by Dr. Osborn and others in Washington and Britsh Columbia.

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Species.—The present study has occasioned the naming of several new species, while at the same time a number of others have been relegated to the synonmy. The number of species of *Tetragoneuria* is therefore hardly increased. A list of the species and their synonymy is given at the end of this paper.

Acknowledgements.—I have already stated from whom specimens were received. To these gentlemen I wish to express my thanks and sincere appreciation of their kindness. To Mr. Williamson and through him to Dr. Ris I am indebted for the use of the notes of the latter on the types in the de Selys collection at Brussels. Had it not been for the careful notes of Dr. Ris, a solution of the synonymy would have been impossible. Through his notes I have been enabled to ascertain the exact values of such forms as *complanata, basiguitata* and *costalis,* though in the latter case Dr. Ris has expressed his doubt of the specimens under that name in the de Selys collection.

Dr. Walker has sent me notes on several specimens of *canis* in his collection and also some suggestions on the color variation of T. cynosura.

Dr. Calvert's paper on Burmeister's types of Odonata has been very useful. Owing to his exact description of the type of *scmiaquea* it is possible to refer *semiaquea* to the position it should properly occupy.

Of all the species described only *costalis* and *spinosa* have not been seen by me. The latter is very rare in collection and has been confounded with *canis* by most recent writers. *Spinosa* is probably a southern species which would account for its rarity in collections.

Little attempt has been made at accurate descriptions of the body pattern, since they are practically identical in all species. Mr. Williamson's extended description will serve as the mean for all other species of the genus.

The wing photographs shown with this paper have been furnished by Mr. Williamson. Originally they were intended to show the complete stages of color development found in one species; and such, with the exception of the wings in which the color reaches the nodus, is actually the case in *T. cynosura*.

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TABLE OF THE SPECIES OF TETRAGONEURIA.

- A. Abdomen of male slender and parallel, a very slight constriction at 3; length 30-33 mm., hind wing 29-32 mm.
 - B. Wings without brown markings; thoracic stripes black.....stella Williamson n. sp.
 - BB. Wings with brown spots at antenodal intersections, sometimes with spaces filled; thoracic stripes metallic, with violet reflections.....petechialis n. sp
- AA. Abdomen of male spatulate, 3 distinctly constricted; sides of thorax rarely metallic, and only on sides below.
 - B. Male appendages with tips widely separate, an inferior angle at basal third, and a lateral ridge leading beyond, no superior modification; female appendages not exceeding 1.7 mm., vulvars flattened, divaricate. V-shaped, the tips divergent.
 - C. Color of hind wings not exceeding last antecubital; T-spot usually present, or indicated by metallic reflection in median frontal sulcus; length abdomen rarely less than 28 mm. (28-32), hind wing 28-32 mm.; thoracic pile predominately gray.
 - D. Brown of hind wings reaching base of triangle, or less.....cynosura Say
 - DD. Brown of hind wings reaching tip of triangle and filling it, or more.....simulans n. n.
 - CC. Color of hind wings reaching nodus; T-spot absent: length abdomen rarely more than 27 mm. (23-27, hind wing 24-26 mm.; thoracic pile predominately brown....semiaquea Burmeister
 - BB. Male appendages with tips approximate, the inferior angle produced, no lateral ridge beyond angle, no superior modification; female appendages longer than 1.7 mm., vulvars U shaped, the tips parallel.
 - C. T-spot absent; small species, abdomen 29-31 mm., hind wing 31 mm.; female appendages 2 mm.; hind wing with streak to first antenodal....... willlamsoni n. sp.

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CC. T-spot present; large species, abdomen 33-35 mm., hind wing 32-34 mm.; female appendages 3-3.3 mm.; hind wing with color streaks reaching beyond second antecubital (beyond t in the type)morio n. sp.

BBB. Male appendages with inferior spine, no inferior angle; female appendages 3-3.3 mm., vulvars U-shaped, the tips parallel; hind wings with color streaks to level of the base of the triangle (to level of tip in morio); wings hyaline, no flavescent tinge; T-spot always presentspinigera Selys

- BBBB. Male appendages with superior modification; no Tspot.
 - C. Superior appendage slightly curved with sharp spine at apical third above, an inferior obtuse angulation at basal third (not rectangular as in the preceding species); wings hyaline, clear, no flavescent tinge; female ?.....spinosa Hagen

 - CCC. Female appendages 4.5 mm.; wings with costal streaks of brown; male unknown..costalis Selys

Tetragoneuria stella Wiliamson, sp. nov.

Labrum golden, elyeus and frons olive or yellowish, the latter and on the sides usually lighter, the frons in one specimen being as bright as the labrum. Vertex olive, with a black border on the frons in front of the vertex, this black produced on either side and anteriorly in the suleus of the frons, and including the black antennæ. Hair on face pale, cream colored, excepting on frons where it is black. Rear of eyes black.

Thorax yellow or yellowish brown with white or nearly white pile. The humeral and second lateral sutures each with a black stripe, widest above; the humeral stripe very narrowly connected with a spot at the base of the middle legs; the metastigma narrowly surrounded by black.

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Wings may be entirely hyaline without trace of spots, the membrane sometimes with faint fumose. In every case the front wings are without spots and the maximum development of color in the hind wings is as follows: a basal spot on either side of the subcostal vein most developed on the posterior side (in the subcostal space) and extending along the vein to the first antenodal, the membrane on either side of the first antenodal slightly but distinctly tinged with brown in the subcostal space; a basal spot in the cubital space, reaching about half way to the cubito-anal across vein, which may have brown traces on either side and posterior to it; a brown spot in the anal triangle on either side of the cross vein, its greatest area on the anterior side of the cross vein, in its maximum development the anterior third and posterior third or fourth of the anal triangle remaining hyaline; the V-shaped cross vein on the distal side of the anal triangle margined with brown. Costa front wings distinctly vellow at base. Membranule white, in the male more or less with brown posteriorly against the anal triangle.

Legs dark reddish brown, bases of all and femora of the first pair pale.

Abdomen long and slender when compared with species of the cynosura group. \Diamond .—Seen in profile of nearly uniform width after segment 3. segments 2 and 3 moderately dilated and largely yellowish, slightly darker than the thorax in color. From above the last seven segments are of nearly the same width, black in color, each segment with a long yellow spot on either side, reaching the lateral margin, and on the anterior segments occupying the entire length of each segment except the extreme apex and base, reduced on the posterior segments and not present on 10: articulations between segments a narrow yellow ring; the lateral spots on the last seven segments, described above are so nearly joined that the abdomen might be described as black with a yellow interrupted stripe on each side. The black area on the dorsum of segments five and six at the narrowest point is 1.5 to 2 mm. wide.

Q.—Flattened in profile, in dorsal view tapering from 3 to the apex; in dried material distorted and shrunken as is so frequently true of the females of many Cordulines. Similar in color to male, the black dorsum beginning on 2, and the lateral spots continuous, forming lateral vellow stripes, and extending on to 10.

Male abdominal appendages.—Superior appendages seen in profile spatulate, with an obtuse inferior angle at one third the length, this angle inconspicuous; if the appendages of *stella* and any of the

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cynosura group are compared the differences in the superior appendages seen in profile are striking—cynosura high arched dorsally and excavated ventrically at the base, with a resultant prominent ventral angle, and a decidedly unsymmetrical outline; stella, on the other



Figure 1.—Details of venation; left figure showing relation of substigmal series to postnodals; right figure illustrating coincidence of cubito-anal cross-vein with A4. From *T. spinigera*.



hand, without this arching and excavation, and with an outline almost symmetrical. Seen from above the superior appendages of *stella* have a dilatation on the inner side just distal to the apex of the inferior appendage; the latter is relatively shorter than in the *cynosura* group.

Length abdomen (incl. appendages) : & 33-34. 9 33-34 mm.

Length fore wing: 3 30-32. 5, Q 32.5-33-5 mm., average 3 31.7, Q 32 mm.

Material studied: 3 8.19, West Palm Beach, Fla., March 11th, Pennsylvania State Museum, Harrisburg, Pa., all bearing the accession number 8759 r, one male with last seven segments and one male with last six segments lost, female teneral and distorted, apices of left wings gone.

5 δ, 3 φ and four wings of a δ, all collected by Mrs. Charles C. Deam and in my collection: 4. δ West Palm Beach, Fla., Feb. 22 and Feb. 24, 1904; one δ. Rockledge, Fla., March 2, 1904; 3 φ, Lantana, Fla., Feb. 23, 1904.

Holotype §. West Palm Beach, Fla. Feb. 22. 1904; allotype \Diamond . Lantana. Fla., Feb. 23, 1904, Mrs. Charles C. Deam, collection E. B. Williamson.

This species is named for Stella Mullin Deam, who has collected much botanical and zoological material in Florida. The botanical material has been collected for her husband, Charles C. Deam. I am indebted to her for the specimens of this new species as well as for many other dragon flies from Florida.

When I received these specimens in 1904 I thought they represented an undescribed species. One of each sex was examined by Dr. Calvert and it was through him that I received for study the specimens belonging to the Pennsylvania State Museum. Later specimens were sent to Dr. Ris for comparison with material in the de Selys collection. After this examination by Dr. Ris some new questions as to identity came up and specimenswere sent a second time to him. As a result of this double examination and study by Dr. Ris he sent me several closely written pages of notes, representing a great deal of work and time on his part. It is through his care and interest that I am now able, seven years after first studying the material, to describe this species as new.

Dr. Ris's notes on *Tetragoneuria* have been turned over to Mr. Muttkowski for a proposed revision of the genus. It is interesting to note that Dr. Ris found *stella* in the de Selys collection under the label *cynosura*. One of these specimens is from Louisiana (Morrison), the other from Georgia (Morrison). In Dr. Ris's opinion *stella* is quite distinct from all the *cynosura* group by the form of the abdomen (narrow, not spindle shaped), by the color of the abdomen, and by the superior abdominal appendages of the male, which are longer and have a second distal dilatation.—*E. B. Williamson*.

I have the types before me and have compared them with other material on hand. Mr. Wiliamson's species is well represented in the lots before me by the following specimens:

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A1.	ę	Bisc. Bay, Fla., Mrs. A. T. Slosson; coll. Calvert.
A2.	8	Lake City, Fla.; Milwaukee Museum.
A3.	ę	Lake City. Fla.; Milwaukee Museum.
A4.	8	Lake City, Fla.; Milwaukee Museum.
A8.	8	Haulover, Fla., March 13th, Hubbard & Schwartz; U.
		S. N. M.
A9.	Ŷ	Haulover, Fla., March 13th, Hubbard & Schwarz. U. S.
		N. M.
A10.	ę	Haulover, Fla., March 2, Hubbard & Schwartz. U. S.
		N. M.
B1.	8	Lake City, Fla.; Milwaukee Museum.
B3.	З	Lake City, Fla.; Milwaukee Museum.

Of these A8 is an exceptionally fine male in beautiful coloration; the black of the abdomen starts on the posterior half of 3. I am in doubt of another specimen B1 which differs from the remaining by its smaller size and the clearness and transparency of its wings; all the others show a decided tinge of yellowish dulling throughout the wing; in addition the stigma of B1 is shorter. The form of appendages and other characters, however, lead me to place it with T. stella.

Besides the characters shown in the table Mr. Williamson adds the following notes from his material:

Antenodals: fore wings 6 in 4 wings, 7 in 22 wings; hind wings 4 in 23 wings, 5 in 3 wings, 7 in 3 wings.

Postnodals: fore wings 5 in 9 wings, 6 in 12 wings, 7 in 7 wings, 8 in hind wings, 5 in 4 wings, 6 in 1 wing.

Cubital vein: coincident with A4 in 6 wings of the males, distal in 12 wings.

Substigmal series arising: fore wings, between 3-4: 10 wings; at 4: 6 wings; between 4-5: 8 wings; opposite 5: 1 wing. Hind wings, between 3--4: 15 wings; opposite 4: 4 wings; between 4-5: 7 wings; opposite 5: 1 wing.

Triangle fore wing free: 2 wings; crossed: 24 wings.

Tetragoneuria petechialis, sp. nov.

3.-Colors brown, yellow and olive.

Labrum bright yellow, face with olive band, frons bright yellow (except in C4). Vortex olive, a black line at the base, slightly produced in the middle along the frontal sulcus. Antennæ black. Hair on frons and vertex black, otherwise pale. Thorax yellowish brown, covered with white pile which is longest dorsally. Humeral, first suture below and second lateral suture with dark stripe, widest above, of metallic blue, showing a decided violet reflection.

Wings hyaline, membranule white, slightly fumose at the lower end. Fore wings with small basal spot in C and Sc half way to or reaching the first antenodal, the first and second antenodals with a small fuscous spot surrounding the intersection at Sc. A linear spot surrounding the nodus. Hind wings with costal and subcostal streak half way or to the first antecubital. All antenodals with fuscous at the intersections, nodus with linear spot. A brown spot in the cubital space at the extreme base reaching to the marginal vein. A spot in the lower half of the anal triangle, following the oblique vein which divides this triangle, or filling the lower half. Costa of fore wings yellow at base.

Legs dark brown, bases and fore femora yellowish.

Abdomen long and slender as in the foregoing species, segments two and three moderately dilated. Segment 8 as long as 9 + 10. Dorsum black, a yellow stripe occupying the lateral fifth of each side of 3 to 9, reduced on the posterior segments. Male appendages intermediate between *cynosura* and *stella*, though more nearly related to the latter.

Q.—Much like the male. The segment 10 of the abdomen shows a small yellow spot on each side which is absent in the male. The female appendages are longer than those of *cynosura* and less spiculiform. Vulvars slender and recurved, not flattened and divaricate as in *cynosura*, the tips sub-parallel.

Length abdomen: & 28-31, Q 31 mm. Hind wing: & 27-31, Q 30 mm. Average wings 30 mm., abdomen 30.

Described from the following material:

C1. 3	Round Mt.	Blanco Co., Texas, 2	April 25, 1894 ; ee	oll, Ca	lvert
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- C2. Q Round Mt. Blanco Co., Texas, Schaupp; coll. Calvert.
- C3. & Round Mt. Blanco Co., Texas, April 9, 1894; Milwaukee Museum.
- C4. & Cypress Mill, Texas, April 10, 1893; A. N. S. Phila.
- C5. 9 Florida, March 6, 1899, Blatchley; coll. Williamson.

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TABLE II. Tetragoneuria petechialis, n. sp.

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Holotype male--C3--Milwaukee Public Museum, allotype female ---C2---and paratypes in coll. Calvert.

The species is at once distinct from the others by the narrow abdomen, the form of the appendages and the conspicuous spots at each antenodal of the hind wings. I was greatly in doubt whether to name this species or not; yet, as will be later apparent, it did not seem to belong to any of the forms listed.

Tetragoneuria cynosura Say.

& .--- Colors brown, yellow and black.

Labrum and frons yellow, face with an olive band, the pile on the frons black. Frons above showing various degrees of a black T-spot, from a mere indication of the black stem to the fullest development of stem and cross piece, the latter then covering the entire width of the frons. Usually, however, even in such cases where the stem of the T-spot is rudimentary, there is a metallic glint in the median frontal sulcus. Vertex and antennæ black, head black behind.

Thorax brownish yellow, humeral and lateral sutures with irregular spots of bright yellow. Usually the black stripes show but little or no metallic glints, and then only in fully matured specimens; these metallic glints are confined, as a rule, to the latero-inferior convex plates of the thorax though occasional specimens may have the metallic glints farther up below the wings, in which case the pile hides most of the iridiscence. In no case is the metallic reflection as bright as in *petechialis*; the latter shows decidedly violet reflections throughout the extent of the lateral stripes, while *cynosura* may show dark blue reflections, which are confined to the lower lateral ridge.

Legs black, fore femora and bases of all legs, luteous.

Abdomen flattened, and therefore appearing shorter than stella and *petechialis*, usually constricted as segment 3 after a moderate dilation of segments 2 and 3. Segments often "telescoped", a comparison is therefore uncertain. Yellow lateral stripes interrupted at base and apex of segments, absent on 10.

Appendages spatulate, an inferior angle at the basal third, a lateral ridge continued for a short distance beyond the inferior angle. Viewed from above the appendages divaricate.

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Q.—Similar to the male. Middle femora often luteous. Segment 10 of abdomen with small lateral spots of yellow. Vulvars divariente, flattened, the tips subacute. Appendages short, spiculiform, pointed.

Length abdomen (incl. app.) 27-31 mm., hind wing 27-31 mm. Though exhibiting some variability, the appendages of *cynosura* are



Figure 3.—*T. cynosura* Say. The two bottom figures to the left are from a male (B12) which approximates *T. williamsoni*.

distinctive from those of the two preceding species and *semiquea*. Occassionally a specimen, such as B12, approaches *stella*, but if the regional difference be taken into account there is little difficulty in separating the forms.

In width of the abdomen there is much variation. The series from Wisconsin, F10-F30, shows much variability. Thus F11 is

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sub-parallel, segment 5 is but 2 mm. wide at the base, while F23 is 3.5 mm. at the same segment. As a rule the apical segments have a wider expansion than the constriction at 3, and also the 9th and 10th segments are markedly narrower than the preceding ones. The insects therefore present a much different appearance from the slender and parallel form of *stella* and *petcchialis*.

As to wing markings the long series on hand permit a division into more common forms, though intermediates are not wanting. Certain types, however, usually from a single region, show constancy in the type of their markings. For convenience the following division of color types was made, applying only to the hind wings:

c1.	Colors	reaching	half way to the first antenodal.
c2.	66	"	to first antenodal.
d.	66	"	base of triangle.
e.	66	66	tip of triangle.
f.	66	extendin	g beyond tip of t, and to third antenodal.
g.	66	66	" " t, " " fourth "

Very rarely a specimen exceeds the latter type of coloration. Of these forms c1 and c2 and e and f are more common. Their distribution and increase in color markings is from south to north, a striking phenomenon and the direct opposite of what we find in Epicordulia princeps. The transition of forms from cI to f is so close and regular that there can be little doubt of their identity. Yet if extremes, cI and g, be placed side by side they would hardly be considered identical. CI is the form described by Say, while all the rest of the names (basiguttata, lateralis) are synonymical. I am loath to rename any of the various forms of cynosura since their identity is so obvious. Nevertheless, after much consideration I have decided to name the extremes represented by forms cI to d and forms e to g, more as a matter of advisable convenience, and to prevent future synonymic entanglement, than because of natural distinctions. In doing so its seems advisable to have each name cover as large a series as possible.

Hindwings with markings reaching the base of the triangle or

less..... cynosura cynosura Say Hindwings with markings reaching to tip of triangle and beyond

.....cynosura simulans n. n.

	Place	Ν. Υ.	$\mathbf{Pa.}$	N. Y.	Ia.	Ind.	0hio	Ohio	Pa.	Ind.	Ia.	Ind.	Ia.	N. J.	Ind.	Ind.	Ind.	$0hi_0$	Ia.	Ia.	N. J.	Ind.	Ia.	N. Y.	Kans.	Mich.	Mich.	III.
olor	toq2-T	abs.	shad.	shad.	shad.	shad.	shad.	abs.	•	shad.	shad.	shad.	shad.	abs.	pres.	pres.	abs.	pres.	pres.	pres.	pres.	shad.	pres.	shad.	abs.	abs.	abs.	abs.
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sth	ъ. w .	28 88	29	29	30	30	29	30	30	29	32	30	29	28	30	29	59	29	39	30	29	ŝ	66	30	33	30	31	30
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	.bdA	30	80 80	56	31	30	30	31	30	28 88	30	30	29	59	50	29	30	27	30	31	20	$^{28}_{28}$	$\overline{3}9$	÷	31	31	29	29
ion	.W .I J	+	+	+	+	+	+	+	+	÷	+	•+-	+	+	+	÷	÷	+	:	+	-}-	+	+	+	+-	-+	+	+
Venat	ni9v-uD	eoin.		coin.	coin.	dist.	dist.	coin.	e/d	dist.	:	d/c	coin.	e/d	coin.	dist.	dist.	coin.	coin.	dist.	•••••	coin.	dist.	dist.	coin.	dist.	•••••	
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Postn	.w. Я	5-5	5-5	5^{-5}	5-5	6 - 5	7-6	5-6	6-6	5 - 5	$\tilde{0} - \tilde{0}$	6-6	6-5	5 - 5	6 - 5	5 - 5	6 - 5	5-5	4-5	5-5	5-5	5-5	6-5	8-7	6 - 5	2-9	5-6	4-4
odals	.чН	4-4	4-4	4-4	5-4	+-+	4 - 4	1 -+	4-4	4-4	4-4	5-4	5-5	4-4	5^{-4}	4 - 4	4-4	4-4	4-4	1-1	4-4	4-4	1-4	4-4	4-4	4-4	4-4	4-4
Anten	F. W.	2-2	9-9	99	2 - 9	2- 1 2-	2-9	6 - 6	6 - 6	6-6	7-6	8-7	2-2	6-6	99	$^{9-9}$	2^{-6}	6-6	6-6	2-9	6 - 6	$^{9-9}$	26	8-8	6-6	6-6	6 - 7	6-6
	xəs	~~	0 01	. « 0	60	€0	€0	60	€0	60	0+	€0	- €O	60	60	€0	€0	40	40	60	0+	÷0	€C	€0	€0	40	0+	0+
	nədmuN	Bi	B4	B5	B8	B10	B11	B12	B13	B14	B15	B16	B18	B19	B20	B21	E22	1 23	1'24	1325	L26	B28	B29	F44	F45	F48	F49	F50

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Tetragoneuria cynosura Say, Color type c.

TABLE III.

Muttkowski, Studies in Tetragoneuria.

MATERIAL STUDIED.

1. Color type c1, cynosura Say.

B2. Staten Island, N. Y., June, W. T. Davis; coll. Calvert. B4. Q Folsom, Del. Co., Pa., June 6th, 1892; coll. Calvert. B5. 8 Lake George, N. Y.; coll. A. N. S. Phila. Waterloo, Ia., June 7, 1906; N. Miller; coll. Williamson. BS. 8 Bluffton, Ind., June 23, 1907; coll. Williamson. B10. 8 Danville, Ohio, June 22, 1899, J. B. Parker; B11. 8 coll. Williamson. Spring Grove, Ohio, June 26, 1898, Chas. Dury; B12. 8 coll. Williamson. Westmoreland County, Pa., May 30, 1899;coll. 1313. Williamson. Blue River, Ind., June 10, 1903; coll. Williamson. B14. Waterloo. Ia., June 8, 1906, N. Miller; coll. Williamson, B15. Q Wells Co., Ind., May 22, 1900; coll. Williamson. B16. 8 Waterloo, Ia., June 7, 1906, N. Miller; coll, Williamson. B18. 8 Newark, N. J., May 9, 1896; coll. Williamson. B19. 8 Bluffton, Ind., June 16, 1903; coll. Williamson. B20. 8 Bluffton, Ind., May 28, 1905; coll. Williamson. B21. 3 B22. Same. Mahoming Co., Ohio, June 10, 1900; coll. Williamson. B23. 8 Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson. B24. 8 B25. 8 Same. Newark, N. J., May 9, 1896; coll. Williamson. B26. Ŷ Elkhart, Ind., May 20, 1900; coll. Williamson. B28. 8 Waterloo. Ia., June 7, 1906, N. Miller; coll. Williamson. B29. 8 New York, C. V. Riley; U. S. N. M. F44. 8 Kansas, C. V. Riley; U. S. N. M. F45. 8 F48. Detroit, Mich., Hubbard & Schwartz; U. S. N. M. 8 F49. Q Same. Summit, Ill., May 19, 1906, J. D. Hood; coll. Williamson. F50. Q 2. Color type c2, cynosura Say. Bluffton, Ind., May 28, 1905; E. B. Williamson; coll. **B6**. 8 Calvert. B7. Same. 8 Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson. B9. Q Bluffton. Ind., May 28, 1905; coll. Williamson. B17. 8

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	Place	Ind	Ind	Ia.	Ind	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	N.	Pa,
olor	joq2-T	pres.	pres.	pres.	shad.	abs.	abs.	shad.	abs.	abs.	abs.	abs.	abs.	abs.	a bs.	shad.	abs.	abs.	abs.	shad.	abs.	abs	abs.	· a bs.	abs.	abs.
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sth	Б. W.	59	29	30	30	:08 8:	56	29	30	30	30	30	30	30	08	66	29	30	66	30	68	29	50 50	30	: S S S	31
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	.bd A	30	66	35 80	- 32	65 X	27	28	83 80	ŝ	28 82	2- 01	68	28	$\stackrel{\infty}{\circ}_{2}$	2 02	222	27	31	:	27	$\frac{63}{8}$	23	22	27	28
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Venat	ni9v-uO	eoin.	coim.		eoin.	eoin.	••••••	coin.		•	coin.		coin.	•	c/d	••••••	••••••	••••••	eoim.	dist.	dist.	coim.	dist.	coin.	coin.	eoin.
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gub	. w. î. М.	070 07	03 10	+	++	ಣ	33	4	4	03 10 10	Ŧ	ಾ	50 100	4	50 100	-(01 	- 101 101		≓°1 ℃	20		331	03 10	+	en	4
odals	.w .H	5-5	6-5	6-6	2-2	5-6	6-5	6 - 6	6 - 6	6 - 5	5^{-6}	5-7	5-5	2 - 2	2 - 3	5-5	6-6	2-9	9-2	2 - 2	5^{-2}	5-2	$^{0-9}$	$^{0-9}$	6-5	2-9
Postn	. ч. ч.	5-5	6-6	2-3	6-6	4-5	5^{-6}	6 - 6	6 - 5	5-5	6-6	6-6	5 - 5	7-8	5 - 5	5-6	10 1	6 - 6	6-5	8-7	5 - 5	5 - 5		6-5	5-5	6-6
odals	.w .Н	5-4	4-4	4-4	+-+	4-4	4-4	4-4	4-5	4-4	4-4	†−]-	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	44	4 - 4	4-4	5−5
Anten	. ч. Э	9-9	$^{0-9}$	2-9	2-2	6-6	6-6	2^{-2}	2-1-2-	6-6	2- 1-	2-2	9-9	2-2	9-9	6-6	-2-	2-2-	9-2	2-2	2-9	9-9	2-2	6-7	2-6	2-8
	xəS	۴O	€0	0+	€0	€0	0+	€0	60	0+	⁶ 0	0+	€0	0+	€0	0+	0+	0+	60	€0	~ 0	60	€0	€0	€0	60
	Number	B6	B7	139	B17	B27	B30	D27	1)28	1)29	D30	D31	D32	D33	D34	D35	D36	D37	D38	D39	D40	D41	D42	D43	D44	Föl

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TABLE IV. Tetragoneuria cynosura Say. Color type e2.

Muttkowski, Studies in Tetragoneuria.

	Place		Ind.	Ia.	Ind.	N. C.	N. C.	Ind.	Mass.	N. Y.	Ohio
lor	joq2-T		pres.	pres.	pres.	pres.	pres.	pres.	shad.	abs.	abs.
Co	szaiW		q	q	d-e	d-e	d-e	d-e	d-e	d-e	
	. ч. н		26	28	02 00	28	30 20 20	53	27	% %	29
th	Б. W.		55 S	29	29	29	29	30	50 80 80	29	30
Leng	.qqA		°2	ĉ	e0	•		33		•	en
	.bdA		53 25	29	28 88	:	62	30	29	30	30
ion	.w.ìj		-{-	+	-+-	+	-+-	+	-+-	- † -	+
Venat	tiəv-uD		dist.	coin.	coin.	coin.	d/e	dist.	coin.	dist.	eoin.
es	М. А.Я		101	4	50		33 23 23	$\frac{4}{5}$?1 -+	3	-03 -03
ul seri at	г. р. м.			33	-1 1,	10	0	44	$\frac{4}{4}$	ŝ	4
stigme	R. f. w.		с?	$4\frac{1}{2}$	- 	50	03 202	4	03 44 84	33	33
Subs	.w.i.ь.l		331	$\frac{4}{3}$	43	3 33	31	$4\frac{1}{2}$	⊷ റാ	~	33 231
odals	.чН		2-2	6-6	6 - 6	8-6	5 - 7	2-2	2-9	5-6	9 - 0
Postne	F. W.		5-5	66	2^{-6}	5-6	5 - 5	6-6	6 - 6	6 - 6	99
odals	.чН		4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	5 - 5
Anten	. т.		2-2	9-9	9-9	7-6	6-6	2-2	7-7	2-3	2-2
	xəS	2	*C) ≮O	*0	o ≪c) ≪C) ≮C) €C) ≮C	, €O
	Number		D25	EI	D26	D46	D47	E3	C5	F47	F52

TABLE V. Tetragoneuria cynosura Say, Color type d, and intermediates.

1911]		Muttkowski, Studies in Tetragoneuria. 111
B27.	8	Raleigh, N. C., April 24, 1903, C. S. Brimley; coll. Williamson.
B30.	ę	Raleigh, N. C., April 11, 1903, C. S. Brimley; coll. Wilson.
D27.	8	Raleigh, N. C., April 24, 1903; coll. Brimley. ,
D28.	ę	Lumberton, N. C., April 7, 1903; coll. Brimley.
D29.	Ŷ	Raleigh, N. C., mid-April, 1908; coll. Sherman .
D30.	3	Raleigh, N. C., March 24, 1903; coll. Sherman.
D31.	Ŷ	Same.
D32.	3	Same.
D33.	ę	Old Fort, N. C., Sept. 9, 1902 ; coll. Sherman.
D34.	8	Raleigh, N. C., March 24, 1903; coll. Sherman.
D35.	Ŷ	Same.
D36.	Ŷ	Lumberton, N. C., April 9, 1903; coll. Sherman.
D37.	Ŷ	Raleigh, N. C., March 24, 1903; coll. Sherman.
D38.	8	Same.
D39.	8	Lumberton, N. C., April 7, 1903; coll. Sherman.
D40.	3	Raleigh, N. C., March 24, 1903; coll. Sherman.
D41-4	4. 88	Same.
F51.	8	Westmoreland Co., Pa., May 30, 1899; coll. Williamson.
		3. Color type d, and intermediates d to e.
C5.	8	Sherborn, Mass., A. L. Babcock; coll. Calvert.
D25.	8	Elkhart, Ind., May 20, 1900; coll. Williamson.
D26.	8	Same.
D46.	8	Raleigh, N. C., March, 1903; coll. Sherman.
D47.	8	Same.
E1.	8	Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson.
E2.	8	Bluffton, Ind., June 23, 1907; coll. Williamson.
F47.	8	Baldwinsville, N. Y., June 14th, 1891, N. Banks; U. S. N. M.
F52.	6	Ohio, J. S. Hine; coll. Williamson.
		4. Color type e, simulans n. n.
D1.	8	Bluffton, Ind., May 28, 1905, E. B. Williamson; coll. Calvert.
D2.	8	Same.
D5.	6	Milwaukee Co., Wis., June 4, 1899; Milwaukee Museum.
D6.	8	Ontario, June 20, 1907, E. M. Walker; coll. Williamson.
D7a.	Ŷ	Same.

	Ріасе	Ind.	Ind.	Wis.	Ont.	Ont.	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.	lud.	Ind.	Ind.	Ind.	Ind.	N. C.	N. C.	N. C.	N. C.	Ind.	III.	Ind.
olor	joqz-T	pres.	pres.	pres.	pres.	pres.	pres.	pres.	abs.	shad.	pres.	shad.	pres.	pres.	pres.	pres.	pres.	pres.	abs.	abs.	abs.	abs.	abs.	abs.	als.	abs.	abs.
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th	F. W.	68	62		30	31	59	66	$\frac{3}{2}$	30	30	31	30	29	30	30 80 80	28	30	39	2 8	00 00	31	29	\$\$ 8	28 88	31	31
Leng	.qqA		<i>c</i> 0	c 2	00	1.7	**		<i>c</i> 2	~	co	eo	~~			~	~		en	e.	2.1	:	ŝ	2.3		1.7	~
	.bdA	50	66	$\frac{\infty}{2}$	29	29	66	62	62	56	30	30	30	63	30	66	30	50	50	29	53	63 X	53 82 82	50 50	30	30	31
ion	.w.ìj	+	+	+		÷	+	-+-	-+-	+	+	+	+	+	· +-	+	+	+	+	+	+	+	•+	+	-}-	+-	+
Venat	ni9v-uD	coin.	coin.	coin.	c/d	:	dist.	dist.	dist.	d/e	coin.	coin.	coin.	dist.	dist.	dist.	coin.	eoin.	coin.	c/d	•	dist.	dist.	dist.	dist.	•••••••••••••••••••••••••••••••••••••••	dist.
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Subs	. т. т. ч.	0	00 100	က	-	50	-(c) -(c)	50 101	03 	4	4	က	$4_{\frac{1}{2}}$	-107 -107	00 00 00	4	+	331		+3 1	4	er.	4	331	0	4	33 22
odals	.чН	5-5 -5	6 - 5	6-5	2-2-2-	9 - 0	6-6	6-6	5^{-6}	66	6-6	6-6	8-7	7-6	6-6	5-6	6-6	5-5	2-2	2-9	9-9	6 - 5	2-2	6-5	5-5	2-2	9-9
Postn	F. W.	5-5	6-6	5-6	$\tilde{e}^{-\tilde{z}}$	6 - 6	6-6	6 - 5	4-5	6-5	6 - 5	5-5	7-8	6-6	5-6	6-5	6-5	5^{-4}	7-8	6-5	99	5-5	$^{9-9}$	5-6	5-4	6-5	5-5
odals	. м. Н	ţ-ţ	5-4	+-+	1-1	+-+	5-4	<u></u> +−+	4-4	4-4	+-+	4-4	5 - 5	+-+	4-4	4-4	+-+	+-+	1 -+	5-4	2-7	1 -7	4-4	4-4	4-4	4-4	+-+
Anten	.wЧ	7-6	2-2	6-7	7-8	6-6	2-2	6-6	6-6	2-0	2-2	2-2	8-8	6-6	$^{9-9}$	6 - 6	6-6	6-6	2-2	S-S	2^{-2}	6-6	2^{-9}	2^{-2}	9 - 9	2^{-9}	2-2
	xəS	60	1 40	i €0	40	0+	60	10	~ 0	€0	€0	40	€0	€0	€0	€0	۴0	€0	40	€0	0+	« 0	1 0	€0	€0	0+	€0
	Number	D1	1)2	D5	D6	D7a	DS	D_9	D10	D11	D13	D14	D15	D16	D17	D18	D19	D20	D22	D23	D24	D45	F44	F45	F34	F53	F54

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TABLE VI. Tetragoneuria cyn. simulans, n.n., Color type, c.

Bulletin Wisconsin Natural History Society. [Vol. 9, No. 3.

1911]		Muttkowski, Studies in Tetragoneuria. 113
D8.	3	Clear Lake, Ind., June 12. 1904. Deam; coll. Williamson.
D9.	3	Bluffton, Ind., June 5, 1904; coll. Williamson.
D10.	8	Clear Lake, Ind., June 12, 1904, Deam; coll. Williamson.
D11.	ð	Blue Lake. Ind., June 10, 1903; coll. Williamson.
D13.	3	Clear Lake, Ind., June 12, 1904, Deam; coll. Williamson.
D15.	3	Same.
D14.	3	Blue Lake, Ind., June 10, 1903; coll. Williamson.
D16.	3	Fort Wayne, Ind., June 17. 1906; coll. Williamson.
D17.	3	Bluffton, Ind., May 28, 1905; coll. Williamson.
D18.	3	Bluffton, Ind., June 23, 1907; coll. Williamson.
D19.	6	Blue Lake, Ind., June 10, 1903; coll. Williamson.
D20.	3	Bluffton, Ind., May 28, 1905; coll. Williamson.
D22.	8	Rome City. Ind., June 7, 1908; coll. Williamson.
D23.	8	Same.
D24.	ę	Raleigh, N. C., April 14, 1903; coll. Williamson.
D45.	8	Raleigh. N. C., March 24, 1903; coll. Sherman.
F34.	3	Elkhart, Ind., May 26, 1897, R. J. Weith; coll. Calvert.
F44.	8	Raleigh, N. C., April 22, 1905; coll. Brimley.
F45.	3	Same.
F53.	Ŷ	Summit, Ill., May 19, 1906, J. D. Hood; coll. Williamson.
F54.	6	Whitley Co., Ind., June 8, 1898; coll. Williamson.
		5. Color type e to f, simulans n. n.
D3.	3	Georgian Bay, Ont., June 20, 1907; coll. Walker.
D4.	3	Go Home Bay, Ont., July 22, 1907; coll. Walker.
D7b.	3	Bluffton, Ind., June 23, 1907; coll. Williamson.
D12.	8	Maine, June 26, 1899, Harvey; coll. Williamson.
D21.	8	Blue Lake, Ind., June 10, 1903; coll. Williamson.
F19.	8	St. Croix Dam. Douglas Co., Wis., July 17-22. 1909;
		Milwaukee Museum.
F46.	ð	Manchester, Me., June 22, 1897, Miss Wadsworth; U.
		S. N. M.
		6. Color type f, simulans n. n.
F1.	Ŷ	Go Home Bay, Ont., July 21, 1907; coll. Walker.
F2.	6	Go Home Bay, Ont., June 28, 1908; coll. Walker.
F3.	6	Go Home Bay, Ont., June 26, 1907; coll Walker.
F4.	ę	Go Home Bay, Ont., July 5, 1908; coll. Walker.
F5.	ę	Go Home Bay. Ont., June 27, 1907; coll.Walker.
F6.	8	Go Home River, Ont., June 25, 1907; coll. Walker.
E'7	0	Samo

		Place		Ont.	Ont.	Ind.	Me.	Ind.	Wis.	Me.
	olor	joq2-T		pres.	pres.	pres.	pres.	pres.	shad.	pres.
-	Ũ	szniW		e-f	e-f	e-f	e-f	e-f	e-f	e-f
		.чН		30	28	27	27	27	30	27
	th	F. W.		31	29	28	28	28	32	28
	Leng	.qqA		3.3	e	ŝ	co	co	ŝ	en .
		.bdA		31	29	28	27	28	31	29
	ion	.w.î J		÷	+	+	-+-	+	+	+
	Venat	ui9v-uO		coin,	dist.	dist.	dist.	coin.	dist.	coin.
	es	В. ћ. w.		-4- 0300	00 00	43	44	34	-101 CO	=01 CO
	al seri at	г. р. м.		4	50 70 70	4	00 70 70	ŝ	4	03 109-1
	stigme	. ч. т. я		67 67 7 7 7 7	33	4	$4\frac{1}{2}$	31	03 102	31
	Subs	L, f, W.		4 ⊷	33 24	4	331	87 67	331	0
	odals	.м .Н		2-9	9-9	9-9	9 - 9	2-6	2-9	$^{9-9}$
	Postn	.w. Я		2-6	9-9	$^{9-9}$	2 - 9	6-5	6-5	9-9
	odals	.чН		4-4	4-4	4-4	4-4	<u>4</u> -5	4-4	5-4
	Anten	. ч.		2-2	2-2	2-2	2-2	6-7	9-9	9-9
		xəS		6 0	60	40	40	€0	۴0	40
	Number			D3	1)4	070	D12	D21	F19	F46

TABLE VII. Tetragoneuria c. simulans, n. n., Intermediates e-f.

1911]		Muttkowski, Studies in Tetragoneuria. 115
F8.	ç	Go Home Bay, Ont., June 25, 1907; coll. Walker.
F9.	ę	Cottage City, Mass., June 23, 1899, J. P. Morse; coll. Calvert.
F10.	8	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909; Milwaukee Museum.
F11.	3	Same.
F12.	3	Same.
F13.	8	Solon Springs, Douglas Co., Wis., July 7-15, 1909;
121.4	4	St Croix Dam Douglas Co Wis July 17-22, 1909:
F14.	6	Milwaukee Museum.
F15.	8	Same.
F16.	8	Same.
F17.	8	Same.
F18.	8	Solon Springs, Douglas Co., Wis., July 7-15, 1909;
		Milwaukee Museum.
F20.	8	Same.
F24.	8	Same.
F28.	8	Same.
F30.	8	Same.
F19.	8	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909;
		Milwaukee Museum.
F21-23.	88	Same.
F25-27.	88	Same.
F29.	88	Same.
F31.	Ŷ	Manchester, Me,. 1888; coll. Calvert.
F32.	Ŷ	Manchester, Me., May 29, 1889; coll. Calvert.
F33.	8	Same.
F35.	8	Maine, June 4, 1895, Harvey; coll. Williamson.
F37.	8	Orono, Me., June 8, 1899, Harvey; coll. Williamson.
F38.	8	Same.
F39.	Ŷ	Same.
F40.	8	Orono, Me., June 24, 1891, Harvey; coll. Williamson.
F41.	ç	Orono, Me., June 10. 1899, Harvey; coll. Williamson.
F42.	Ŷ	Orono, Me., June 14, 1899, Harvey; coll. Williamson.
F43.	8	Orono, Me., June 7, 1899, Harvey; coll. Williamson.
F55-57	1 1	Orono, Me., Harvey; coll, Williamson.

	P1ace	Out.	Ont.	Out.	Ont.	Ont.	Ont.	Ont.	Ont.	Mass.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.
olor	joqz-T	pres.	pres.	pres.	pres.	pres.	pres.	pres.	pres.	abs.	pres.	pres.	shad.	abs.	abs.	pres.	pres.	pres.	abs.
	szaiW		4	f	Ŧ	f-o	4	÷	ч	4	4	4-1	+	4	f	4	41	4	f
	.чН	30	38 88	30	32	30	29	31	31	29	29	30	30	30	29	29	28	30	30
sth	.w. Ч	31	29	31	33	31	30	32	32	30	30	31	31	31	30	30	29	31	31
Leng	.qqA	1.5	ಣ	ŝ	1.7	1.5	ŝ	1.7	1.7	1.7	ero A	က	e	co	က	ŝ	ŝ	က	c
	.bdA	00 80 80	29	31	29	27	31	29	802 802 802	26	30	33	31	30	29	30	30	30	31
ion	. ч. ј ј	+	+	+	+	- -	+		+	+-	<u>+</u> -	+	+	+	+	+	+-	-†-	+-
Venat	aiəv-uD		dist.	d/e		•••••	dist.	· · ·	••••••		dist.	dist.	dist.	dist.	dist.	dist.	e/d	dist.	dist.
ies	В. р. м.	57 87	31 23	31 22	43	÷	32	03 44	33 34	44	$\widetilde{\mathbf{S}}_{2}$	$\frac{4}{16}$	3_{2}^{1}		c 2	31	53 73	$5\frac{1}{3}$	231
at at	гм ч т	43	+		(c1	4	4	$4\frac{4}{2}$	1	-67 -67	e	50 70 70	03 19	312	$\frac{33}{2}$	$3\frac{1}{2}$	331	33 44	33- 33-
stigme	. т. т. Я	-4 -0	· -+	53 133	031 60	+	50 50		-(c) -(c)	03 10 10	4 <u>3</u>	-62 -62	+	4	 	31	93 93	4	en
Subs	L. f. W.	4	ŧ	-+	87 67	$4\frac{1}{3}$	Ŧ	321	3^{1}_{2}	43	333	4	33	4	3 <u>1</u> 3 <u>1</u>	03 197	312	4	32
odals	.w .Н	2-2	£−6	7-6	2-2	2-2	7-6	2-2	6-6	5-6	5-6	2 - 3	5-6	6 - 5	6-6	$^{9-9}$	2^{-2}	7-8	5-5
Postn	Б. W.	7-8	6-6	9-9	6-6	6-6	7-6	9-9	5-6	99	5-6	99	5-6	5 - 5	6-5	6-5	6-6	2-2	5-5
odals	.w .H	4-5	4-4	4-4	4-5	5-5	4-4	4-4	4-5	4-4	5-5	4-4	4 - 5	+-+	+-+	4-4	4-4	+-+	+-+
Anten	., w.	2-2-	7-8	ũ-6	8-7	7-8	8-2	8-2	8-8	6-6	2-2	6-7	2-2	6-6	2-2	2-9	6-6	2-2	2-2-2-
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	nəd m u ^N	1	F.5	E3	F4	F'5	F6	F7	FS	F9	F10	FIT	F12	F13	F14	F15	F16	F17	F18

TABLE VIII. Tetragoneuria e. simulaus, n. n., Color type 1.

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PLATE VI.

WINGS OF TETRAGONEURIA. T. williamsoni, n. sp. T. cynosura Say. T. stella Williamson, n. sp. T. cynosura Say.



PLATE VII.

WINGS OF TETRAGONEURIA. Top figure: T. cynosura Say. Middle and bottom figures: T. cynosura simulans n. n.



WINGS OF TETRAGONEURIA. Top figure: T. cynosura simulans n. n. Middle and bottom figures: T. semiaquea Burmeister.

	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Wis.	Me.	Me.	Me.	Me.	Me.	Me.	Me.	Me.	Me.	Me.	Me.	Me.	Me.	Me.
,	abs.	abs.	shad.	pres.	pres.	pres.	shad.	pres.	shad.	pres.	shad.	shad.	pres.	shad.	shad.	abs.	abs.	abs.	abs.	abs.	abs.	abs.	abs.	abs.	abs.
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		31	31	31	31	31	31	31	31	31	31	30	29	29	29	59	29	62	62	59	31	50	29	29	30
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	+	+			+		-+-	+	+	-+-	+-	-+-	+		+	+	+	+	+	+	+	+	+		·+·
	dist.	dist.	e/d	coin.	c/d	dist.	dist.	dist.	d/e	dist.	dist.	•	•	coin.	dist.	dist.	dist.	•	d/e	•	•	dist.	dist.	dist.	dist.
		+	22 22	33			53 57	-101 -101	23 7 7 7 7 7	<u> </u>	034 03	<u>5</u>	$3\frac{3}{2}$	5,4	-	331	+	60 70 70	-	4		-67	4	31	€01 F(01
			+			+		33	+	33	4	33	03 201	07 C2		+	+	4^{1}_{2}		-+	-(e) 01	-/:-1 -/:-1	+	0	43
	 ++		,	· +	+ (c)			+	+	+	್ಷ	-07 -07	3 <u>1</u> 22	+	331	0.43 133		33 231		00-4 00-4	933 933	50	:	4	+
7		- #	100		-01	+	+	-(c)2	50 100	+	5	02 22	10	10	0	33 33	43 84 84	41	07F		53	+	0	50	77
	6-7	2 2	2-0	9-9	2-3	2-2	6 - 6	6-5	. 99	6-5	6-5	5-5	6-5	6-5	6-6	2-2	$^{8-6}$	6 - 5	2-2-2-	2-2	2-9	6-6	2-2	5-5	2-0
	6-6	6-6		5-6	26	2-3	6-6	6-6	6-7	5-6	5-5	<u>5</u> -5	5 - 5	6-6	5-5	5 - 6	2-2	6-5	6-6	5-4	6-6	6-5	5-	5 - 5	6-6
	<u>-</u> -+	+-+	+-+	+-+	1-1	4-4	+-+	4-5	4-4	4-4	+-+	1-1	4-4	+-+	+-+	+-+	ũ−4	1-1	4-4	<u></u> +−+	4-4	1-1	1-1	Ť-Ŧ	4-4
	2-2	2-2	6-6	6-6	2-2	6-6	2-1-	2-2	2-9	2-9	9-9	7-6	6-6	6-6	S-7	9-9	2-6	99	66	6-6	2-2	6-6	6-6	6-6	6-6
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	F20	1.0.1	66.1	123	1.24	1.25	F26	F27	I^28	F29	F30	F31	F32	F33	F35	F37	F38	F39	F40	F41	64.1	F43	1255 2	P56	F57

1911] Muttkowski, Studies in Tetragoneuria.

Tetragoneuria semiaquea Burmeister

This species, hitherto known as *complanata* Rambur and as representing the extreme of the *cynosura-semiaquea-complanata* series, I regard as distinct. It is essentially an Atlantic coast species covering the region from Massachusetts to Georgia.

Its main distinction from *cynosura* and *simulans* is the smaller size and the wing markings, though some minor points exist such as the largely brown pile of the thorax—grayish-white in *cynosura*—and the more marked tubercle on the superior appendix of the male.

Head, thorax and abdomen of typical coloration. T-spot absent, never more than the stem visible in black. Thorax with pile largely brown, so that it is little apparent. The lateral stripes occasionally with a metallic glint.

Wings with brown reaching to nodus. Three forms are usual:

i—color to nodus, often reaching beyond nodus in the space between M3 and Rs and M3-4, then to hind margin beyond level of triangle, occasionally to hind margin at level of nodus.

i2—color to nodus, then in oblique irregular line to the anal angle. or two to three cells along the hind margin, usually before level of triangle. (*Semiaquea* type and *complanata* types).

i3-color to nodus, then in a nearly straight oblique line past the triangle to the anal margin, usually leaving the lower end of the anal triangle free.

Extreme cases of *simulans* can be easily distinguished by the transparent axial streak at the base of the wings which occupies the median space, at least the centers of the cubital and hyper-triangular spaces and part of the anal triangle, and finally the arcular space, extending to near the level of the apex of the triangle. In *semiaquea* these spaces are much infumated and the hypert: iangular and cubital spaces are brown, rarely with more than lighted centers.

The identity of this species occasioned the most puzzling moments of the present study. The forms of these species seem to be but a continuation of the forms f and g of *simulans*; so I had originally supposed. Leaving the *semiaquea* series—that is those specimens in which the color reaches the nodus—aside for 19111

the moment, it was immediately apparent that for the rest of the *Tetragoneuriæ* the color development showed a progression from south to north: Specimens from North Carolina, Ohio, Indiana and New Jersey showed much less color development than specimens from New York, Maine, Ontario and Wisconsin. This phenomenon was obviously at variance with the apparent development of the *semiaquea* series.

Here, then, existed a state, North Carolina, one of the most southern places from which *Tetragoneuriæ* had been collected, in which the color had reached a higher development in the wing of the species than along the line of its regular geographical distribution. Here, in the compass of a few miles, the same results were achieved which otherwise necessitated a broad geographical expanse of approximately a thousand miles.

To co-ordinate this apparent fact with the real fact of color development from south to north seemed an impossibility.

It was about this time (March) that Mr. Brimley sent me an extensive series of species from North Carolina. These together with other material from North Carolina already at hand, formed the basis of a prolonged study in which the final conclusion was reached that *semiaguea* is a distinct spedies.

Distributing this material among the color divisions c to i, as noted under *cynosura*, it was found that they easily divided into two lots: (a) color not extending beyond triangle and (b) color reaching the nodus.

(a) Among the first lot the large majority fell under the color type c2—the color reaching the first antecubital, two specimens came under the intermediates d-e, while but four fell under e, and none at all under e-f, f and g. Considering this lot in the light of the evidence shown by material from other regions the large majority of forms of c2 was conclusive: it marks the typical southern form of *cynosura*, the first step in the color progression toward the north as found in this species.

(b) The second lot showed the three forms i1, i2 and i3 as before indicated.

A further result was remarkable: only two other specimens, from New Jersey and Massachusetts, reached the high color development shown by the North Carolina forms. Furthermore, the nearest approach to *semiaquea*—the forms f and f-g of *simulans*—occur only in northern states (Wisconsin, Maine, Ontario and Massachusetts), so that in this case the geographical isolation of *semiaquea* seems fairly complete. In as far as the material would indicate I believe *semiaquea* to be an Appalachian species, confined to the Atlantic coast, its distribution in many respects analagous to that of *Erythrodiplax berenice*.

Length of abdomen 22-27 mm. Hind wing 24-27 mm.

MATERIAL STUDIED.

1. Color type i1.

G2.	ô	Lumberton, N. C., April 7, 1903, C. S. Brimley; coll. Calvert.
G5.	8	South Pines, N. C., March 9, 1910, C. S. Brimley; Mil- waukee Museum.
G6.	8	Same.
G11.	3	Lumberton, N. C., April 7, 1903; coll. Sherman.
G12.	ę	White Lake, Bladen Co., N. C., mid-April, 1910; coll. Sherman.
G13.	3	Same.
G14.	8	Same.
G15.	8	Lumberton, N. C. April 7, 1903; coll. Brimley.
G18.	3	South Pines, N. C., April 7, 1908; coll. Brimley.
G19-20.	φç	South Pines, N. C., April 8, 1907. Brimley; coll. Williamson.
		2. Color type i2.
G3.	6	Lake Ellis, N. C., May 14, 1906, C. S. Brimley; coil. Calvert.
G4.	Ŷ	Same.
G16.	ę	Same.
		3. Color type i3.
G1.	8	Clementon, N. J., C. J. Green; A. N. S. Phila.
G7.	6	Lake Ellis, N. C., May 12, 1906, C. S. Brimley; coll. Williamson.
G8.	3	Same.
G9.	3	Same.
G10,	3	Same,
G17.	3	Same.
F36.	2	Massachusetts; coll, Williamson.

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TABLE IX. Tetragoneuria semiaquea Burmeister.

Muttkowski, Studies in Tetragoneuria.

		Place	N. C.	N. C.	N. C.	N. C.	N. C.	N. C.	N. C.	N. C.	N. C.	N. C.	N. C.	N. C.	N. G.	U.V.	N. J.	N. C.	N. C.	N. C.	N. C.	N. C.	Mass.
-		joq2-T	bs.	bs.	bs.	bs.	bs.	bs.	bs.	bs.	bs.	.bs.	.ps.	bs.	bs.	bs.	bs.	bs.	.bs.	ubs.	bs.	bs.	.bs.
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1	ren	.qqA	e0	2.7	2.7	2.5	1.7	2.7	2.5	2.5	3.7	1.7	1.7	2.7	1.3	1.3		c0	00	1.3	e	2- 02	ŝ
		.bdA	62 62	56	÷?	56	62 62	54	25	34	26	24	24	26	5+ 5+ 5	5 †?	26	26	55	83	23	36	22
	lon	. т. т. т	+	+	+	+	÷	+	+	+	-+-	+	+		+	+	+	+	+	+.	+	+	+
	Venat	aiəv - uO	coin.	e/d	coin.	dist.	:	dist.	dist.	dist.	coin.			coin.	•		c/d	dist.	dist.		dist.	dist.	coin.
90	n D	в. ћ. w.	ro,− co	+			-0 200	60 Fiel	23 (51	32	(2) (2)	-01 -01 -01	0	331	0)4 0)4		۰,	50 100	10 10	4	32	e	$4\frac{1}{4}$
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tion	arises	R. I. W.	37 53	ल्म २२	32	31.	32		00	00		63	. 1 1	+	c 2	31	10 00	+	93 73 73	4	32	33 4	+
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	odals	.чН	6-5	2-8	5-5 , -0		2-3	6 - 6		6 - 5	6-7	5-6	6-6	2-0	5 - 5	6-6	2-	6-5	$^{0-9}$	2-2	6-5	6-5	2-2
	Postn	. м. [.] ч.	5-5	7-6	5-5	5-5	õ−6	5-5	5-5	4-4	5-5	19-	6-5	$^{9-9}$	5-5	5-5	<u>i</u> -+	99	5-6	0-0	5-5	5-6	6-5
-	odals	.w.Н	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	+-+	+-+	1-1	₽ -₽	1-1	4-4	+-+	4-4	+-+	4-4	4-4	4-4	4-4
	Anten	F. W.	2-2	2-2	2-2	$^{9-9}$	2-9	66	6-6	6-6	9-9	2-	26	2-2	6-6	6-6	6-6	5-6	2-2	9-9	6-6	9-9	2-2
-		xəS	*0) *c	o ≮c	o ≮c	0 0+	. «c	o ≮c	> ≪c	, +0) O	ю	+ <c< td=""><td>0</td><td>Ю</td><td>- «c</td><td>) ≪C</td><td>) ≮C</td><td>о он</td><td>* *0</td><td>o ≮o</td><td>, ≪C</td></c<>	0	Ю	- «c) ≪C) ≮C	о он	* *0	o ≮o	, ≪C
-		Number	<u>1</u> 2	G5	G6	G11	G12	G13	G14	G15	G18	G19	G20	G3	G4	G16	G1	67	G8	G9	G10	G17	F36

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There can be little question of the identity of *semiaquea* Burmeitser (nec Auctorum) and *complanata* Rambur. Calvert (Trans. Am. Ent. Soc., 25, pp. 27-104, 1898; pl. 1) in his notes on the types of Burmeister has published the following (p. 88):

^{\circ} (type). No T-spot or other black spot on the frons. Front wings unspotted. Hind wings with brown extending along the costal margin from base to nodus, thence obliquely towards the anal angle, the outer margin of the brown being very irregular as the central parts of the cells there are clear; the median, submedian and hypertrigonal spaces, the areas between the sectors of the arculus and above the upper sector of the arculus out to the level of the apex (distal angle) of the triangle are clear.

In his notes made of Rambur's types in the de Selys collections at Brussel, Dr. Ris has written as follows:

Hindwing: brown basal spot in C and S to the nodus, in an oblique line to three cells distally from the end of the anal triangle; the margins of the markings lacerate by the color being reduced to vein borders; central clearings of cells especially in m. (The specimen referred to is the male type of Rambur).

(Of the female type) Hindwing: brownish spot to nodus and on the anal margin to end of anal loop. Between M3 and M4 some brown cells distally of an oblique line between those two points. Very many clear centers of cells.

Tetragoneuria williamsoni sp. nov.

Colors olive, yellow, black and brown.

3.—Labrum and frons rich yellow, face with olive band in middle; vertex olive, frons with a black T-spot. Pile and frons and vertex black, otherwise pale. Antennæ black.

Thorax brown, irregular lateral stripes black, shining in places, but not metallic. Irregular yellow spots enclosed by the stripes. Pile gray, somewhat mixed with brown on the sides.

Fore wings without color. Hind wings hyaline, membranule fumose. A streak of brown in the costal space and sub-costal space to half-way to the first antenodal. First antenodal with small spot at intersection. Lower half of anal triangle margined with brown.

Muttkowski, Studies in Tetragoneuria.

Legs black, fore femora pale.

Abdomen slender, segments 2 and 3 inflated, 3 constricted at middle, 3 to 10 thence slightly spindle-shaped, though much less noticeably than in *cynosura*. Sides with yellow interrupted lines as usual.

Appendages much like cynosura, but lacking the lateral ridge.

Q.—Similar to the male. Wings with color extending to the first antenodal. Abdomen without constriction at 3. Appendages longer than in *cynosura*. Vulvars with lobes gently curved and sub-parallel, somewhat U-shaped—not broadly divaricate and V-shaped as in *cyonsura*.

Length abdomen (including appendages) 27-29 mm., hindwings 26 to 28 mm.





Figure 4.-T. williamsoni n. sp.

Material studied:

Α5.	8	Wister, Okla., June 3, 1907; coll. Williamson.
A6.	Ŷ	Wister, Okla., June 4, 1907; coll. Williamson.
A7.	æ	Same as A5.

Holotype male (A5) and allotype female (A6) in coll. Williamson, paratype male (A7) in Milwaukee Museum.

This species falls exceedingly close to *cynosura*. Yet the differences in the length of the female appendages and the form of the vulvars are such as to make this species fully distinct.

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TABLE X. Tetragonenvia williamsoni n.sp.

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	Number		A5	A6	A7

Tetragoneuria morio n. sp.

Colors brown, black, yellow and olive.

3.—Labrum and frons bright yellow, face with an olive band, T-spot always present. Pile on frons and vertex olive.

Thorax brown, humeral and lateral sutures with irregular black lines, these lines often metallic and enclosing ill-defined yellow spots. The pile on the dorsum gray, on the sides copiously mixed with brown.



Figure 5.—*T. morio* n. sp. The two lower left figures are from the type.

Legs black, fore femora and bases of all legs pale.

Abdomen with typical markings. The form of the abdomen is spindle shaped, more decidedly so than any of the previous species, so that the appearance is distinctly spatulate.

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Wings hyaline, fore wings without color, hind wings with brown reaching the first antenodal in C and Sc. Brown at the intersections of the arculus, at the ends of the triangles and anal veins. A large blot in the lower anal triangle and the adjoining two series of veins.

Male appendages in dorsal view like those of *spinigera*, that is twice curved and with the tips approximated. In lateral view somewhat like *cynosura*, but with a longer, slightly produced angle, and no lateral ridge.

Q.—Similar to the male. The vulvars like those of *spinigera*. Appendages somewhat stouter and longer. The wings with fuscous in



Figure 6.-T. spinigera Selys.

the anal field, usually only along the veins out to the level of the triangle.

Length of abdomen 30 to 34 mm., hind wing 30 to 33 mm. Described from the following materials:

1.	6	Solon Springs, Douglas Co., Wis., July 7-15, 1909; Mil-
		Walkee Museum.
2.	ð	Mame, June 10, 1895, narvey, con. wintenson.
з. 4	Ŷ	Detroit Mich Hubbard & Schwartz, U. S. N. M.
ᱥ	¥	Detroit, shen, it start a sensation of a sense formelo

in collection Williamson, paratype male in collection Williamson, paratype female U. S. N. M. Muttkowski, Studies in Tetragoneuvia.

This species can be regarded as an intermediate between *cynosura* and *spinigera*, to both of which it shows many points of similarity. The male is easily distinguished, while the female presents some difficulty, though separable by the longer appendages.

Tetragoneuria spinigera Selys.

Very much like the preceding species.

T-spot always present, the pile on the sides of the thorax much mixed with brown. Altogether the insect presents a darker appearance than those of the *cynosura* series.

Wings of the male with color like that of *cynosura* c2. The female similar, but with the veins in the anal field, near the base only and not extending out to the triangle, edged with brown.

Length of abdomen 30 to 34 mm., hind wing 30 to 33 mm.

The following material is at hand:

1.	8	Wis., Milwaukee Museum.
2.	8	Milwaukee Co., 1900, F. Rauterberg; Milwaukee Museum.
3.	8	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909; Mil-
		waukee Museum.
4.	δ	Wis., Milwaukee Museum.
5.	8	Dane Co., Wis., June, 1890, E. T. Owen; coll. A. N. S.
		Phila.
6.	Ŷ	Same.
7.	8	Manchester. Me., June 21, 1890, Mis; M. Wadsworth;
		eoll. Calvert.
8.	8	Seattle, Wash., June 15th, 1894, O. B. Johnson; eoll.
		Calvert.
9.	3	Langford, L. B. C., July 20, 1902. R. Osborne: coll.
		Williamson.
10.	Ŷ	Same.
11.	Ŷ	No label; coll. Williamson.
12.	8	Saranac Inn., N. Y., June 14, J. Needham; coll.
		Williamson.
13.	8	Same.
14	1	Clear Lake, Ind., June 12, 1904, Deam; coll. Williamson.

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TABLE XII. Tetragoneuria spinigera Selys.

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